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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/942,451	08/29/2001	Kenneth Andrew Dean	CR01-011	7925

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EXAMINER	
LEURIG, SHARLENE L	

ART UNIT	PAPER NUMBER
2879	

DATE MAILED: 04/01/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/942,451	DEAN ET AL.	
	Examiner	Art Unit	
	Sharlene Leurig	2879	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 December 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,4-13,15-19 and 40* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4-13,15-17 and 40* is/are rejected.

7)☒ Claim(s) *18 and 19* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *12 December 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *0803, 1203*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. The amendment filed on December 12, 2003 has been entered and acknowledged by the examiner. Claims 1, 4, 5, 8-11 and 15 have been amended, claims 2, 3, 14 and 20-39 have been cancelled and claim 40 has been added.

Drawings

2. The corrected drawings filed on December 12, 2003 are accepted.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim 40 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 40 recites the limitation "the solid-electrolyte interface" in line 6. There is insufficient antecedent basis for this limitation in the claim.

Claim 40 is rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential structural cooperative relationships of elements, such omission amounting to a gap between the necessary structural connections. See MPEP § 2172.01. The omitted structural cooperative relationships are: the location of the solid-electrolyte interface. It appears from the language of the claim that the solid-

electrolyte interface is the interface between the structural metallic element and some other layer. It is unclear what the other layer forming the interface is.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

6. Claim 40 is rejected under 35 U.S.C. 102(a) as being anticipated by Isikawa et al. (6,278,231).

Isikawa discloses a field emission device including an anode (Figure 20, element 221) and a cathode comprising a substrate (Figure 19, element 82), a nano-supported catalyst comprising a structural metallic element (81) (column 23, line 58) overlying the substrate and active catalytic particles (201) at a portion of the structural metallic element on a side opposed to the substrate, and a plurality of nanotubes (202) formed on the active catalytic particles.

The Examiner notes that the claim limitations of the catalytic particles being formed by a phase separation process at the solid-electrolyte interface and of the nanotubes being formed catalytically in situ are drawn to processes of manufacturing, which are incidental to the claimed apparatus. It is well established that a claimed apparatus cannot be distinguished over the prior art by a process limitation. Consequently, absent a showing of a difference between the claimed product and the

prior art, the subject product-by-process claim limitation is not afforded patentable weight (see MPEP 2113).

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 1, 4-8, 9-13 and 15-17 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Xu et al. (5,872,422) (of record) in view of Lee et al. (6,514,113) (of record).

Regarding claim 1, Xu discloses a field emission device including an anode (column 19, line 58) and a cathode, the cathode comprising a substrate (Figure 1, element 12) made of glass (column 6, lines 38-41) and a nano-supported catalyst formed on the substrate, the catalyst having active catalytic particles that are less than about five hundred nanometers in diameter (column 8, lines 8-14). The smallest nanotube diameter disclosed by Xu is 20 nm (column 9, lines 44-48). Xu discloses a switching voltage for triggering nanotube emission that is less than eighty volts (column 16, lines 8-10) and which results in a current density of 1 A/cm^2 (column 20, line 14), which is within the claimed range of greater than 0.5 milliamp per squared centimeter.

Xu lacks explicit disclosure of a substrate having a deformation temperature of less than 650 degrees Celsius. Xu further lacks explicit disclosure of a nanotube with a

diameter of less than twenty nanometers. However, Xu discloses that the smaller the catalyst particles are, the smaller the nanotubes can be made to be, and discloses a preference for small-diameter nanotubes for greater emitter density that results in lower cost (column 5, lines 46-51). Xu further discloses that the temperature range for growing the carbon nanotubes is from 300 to 1200 degrees Celsius, and preferably below 700 degrees Celsius so as not to damage the integrity of the device (column 9, lines 1-7).

Lee teaches a field emission device comprising a substrate such as glass (column 7, lines 55-57) having a common deformation temperature that is less than six hundred and fifty degrees Celsius (column 7, lines 63-65). Lee also teaches a nanotube having a diameter of less than twenty nanometers, since Lee discloses that the nanotube can be "several nanometers through several tens of nanometers" in diameter (column 3, line 46-48). Lee teaches that such a small diameter results in "very high electron emission efficiency" (column 3, lines 51-54).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Xu's field emission device with a glass substrate having a deformation temperature of less than 650 degrees Celsius in order to use a well-understood and readily-available material on which the nanotubes can be grown without damaging the substrate and to further modify Xu's device with nanotubes having diameters of less than 20 nm in order to create a device with improved emission efficiency, as taught by Lee.

Regarding claims 1 and 4, the Examiner notes that the claim limitation of the nanotube being obtained by means of a catalytic process in situ is drawn to a process of

manufacturing, which is incidental to the claimed apparatus. It is well established that a claimed apparatus cannot be distinguished over the prior art by a process limitation. Consequently, absent a showing of a difference between the claimed product and the prior art, the subject product-by-process claim limitation is not afforded patentable weight (see MPEP 2113).

Regarding claim 5, Xu discloses a switching voltage of less than fifty volts (column 16, lines 8-10).

Regarding claim 6, Xu discloses active catalytic particles that are thirty nanometers in diameter, and therefore within the claimed range of less than fifty nanometers in diameter (column 8, lines 8-14).

Regarding claim 7, Xu lacks disclosure of nanotube diameter less than 20 nm. However, Xu discloses a preference for nanotubes with as small a diameter as possible in order to provide greater emitter density that results in lower cost (column 5, lines 46-51).

Lee teaches a nanotube diameter of "several nanometers to several tens of nanometers", and therefore discloses a diameter of less than five nanometers, since several is taken to be more than two, but not very many (column 3, lines 46-48).

Therefore regarding claim 7, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Xu's field emission device with nanotubes having diameters of less than 5 nm in order to create a device with improved emission efficiency, as taught by Lee.

Regarding claim 8, Xu fails to exemplify nanotubes having a height to width ratio within the claimed range.

Lee teaches nanotubes having a diameter of "several nanometers to several tens of nanometers" and a length of "several tens through several thousands of times longer than the diameter" (column 3, lines 45-50). Therefore the aspect ratio, which the applicant has defined in the specification as the ratio of length to width, fits within the claimed range of greater than 140 and less than 4500. Lee teaches this aspect ratio as a feature of a nanotube having high electron emission efficiency.

Therefore regarding claim 8, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Xu's field emission device with nanotubes having aspect ratios greater than 140 and less than 4500 in order to create a device with improved emission efficiency, as taught by Lee.

Regarding claim 9, Xu discloses a single-walled nanotube (column 9, line 32).

Regarding claim 10, Xu discloses a multi-wall nanotube (column 9, line 32).

Regarding claim 11, Xu discloses a current density of 1 A/cm^2 (column 20, line 14), which is within the claimed range of greater than 1.5 milliamp per squared centimeter.

Regarding claim 12, Xu discloses a substrate comprising at least one material selected from the group consisting of glass, ceramics and metals (column 6, lines38-41).

Regarding claim 13, Xu discloses a gate spacing of less than 5 microns, which is within the claimed range of less than 25 microns (column 21, lines 26-30).

Regarding claim 15, Xu discloses a device having a distance between an anode (Figure 10, element 303) and the substrate (301), but fails to explicitly disclose the distance.

Lee teaches a device having an anode and a bottom substrate separated by a distance greater than 250 microns and less than 5000 microns as part of a device having high electron emission efficiency and good display qualities (column 5, lines 36-38; column 5, lines 27-31).

Therefore regarding claim 15, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Xu's field emission device with a front anode and a back substrate separated by a distance anywhere between 250 microns and 5000 microns in order to provide a display device of the desired size that affords good display qualities and efficiency, as taught by Lee.

Regarding claim 16, the thickness of the nano-supported catalyst is less than 1 micron (column 7, lines 64-67).

Regarding claim 17, the nano-supported catalyst is comprised of active catalytic particles selected from the group consisting of iron, nickel, cobalt (column 7, lines 38-40) and a metal oxide selected from the group consisting of alumina, silica, and magnesium oxide (column 7, lines 50-52).

Allowable Subject Matter

9. Claims 18 and 19 stand objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

10. The following is a statement of reasons for the indication of allowable subject matter:

The Examiner notes that the Prior Art of Record, Xu et al. (5,872,422) (of record), discloses a nano-supported catalyst comprising a layer containing catalytic particles but lacks a non-porous sublayer containing catalytic particles.

The Prior Art of Record fails to teach or suggest the combination of limitations as set forth in claim 18, and specifically comprising the limitation of the nano-supported catalyst being comprised of a porous sublayer having active catalytic particles supported by a metal oxide structure and a non-porous sublayer having active catalytic particles and a structural metallic element.

Response to Arguments

11. Applicant's arguments filed December 12, 2003 have been fully considered but they are not persuasive.

The applicant has argued that the Xu reference differs from the claimed invention in that the Xu reference discloses "carbon fibers", which the applicant asserts are different from carbon nanotubes in their diameter and density (page 13). However, as there is no positive recitation differentiating the carbon fibers of Xu from the nanotubes of the present invention, the examiner maintains that the Xu reference can be

interpreted to disclose nanotubes. Furthermore, the differences between the Xu reference and the present invention enumerated on page 14 do not correspond to claim limitations and therefore do not have patentable weight. The claim limitation of "the structural metallic element" described on page 15 does not appear in any of the claims rejected as being unpatentable over Xu in view of Lee.

The applicant further argues that the nanotubes of the Xu reference could not be formed to have diameters of 20 nm at a temperature below 650 degrees Celsius (page 15). It is unclear what evidence the applicant has to support this argument. The Xu reference specifically discloses the use of glass as a substrate (column 6, lines 38-40), and further discloses that the growth temperature can be less than 650 degrees Celsius (column 9, lines 1-5). Furthermore, the Lee reference specifically teaches employing a temperature range that does not degrade a glass substrate, specifically less than 650 degrees Celsius, which further contradicts the applicant's arguments that the Lee reference requires a growth temperature that would degrade the glass (column 7, lines 60-65). The examiner directs the applicant to column 16, lines 8-10 of the Xu reference for a disclosure of a switching voltage for triggering nanotube emission that is less than eighty volts and to column 20, line 14 for a disclosure of a current density of 1 A/cm^2 which is within the claimed range of greater than 0.5 milliamp per squared centimeter.

Therefore the examiner maintains that the combination of the Xu and Lee references teach each and every limitation of claim 1.

The applicant's traversal of the rejection of claims 1, 4, 6-8, 12 and 14-16 under 35 U.S.C. 102(e) as being anticipated by Lee et al. (6,514,113) is persuasive. The rejection has been withdrawn.

Conclusion

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sharlene Leurig whose telephone number is (571) 272-2455. The examiner can normally be reached on Monday through Friday, 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nimesh Patel can be reached on (571) 272-2457. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

sll

ASHOK PATEL
PRIMARY EXAMINER